GROWTH IN THE NUMBER OF INTERNET USERS

The nation's largest single provider of commercial Internet services has experienced analogous growth. The firm America Online Incorporated, a publicly traded company with annual revenues approaching US$ 2 billion, has been the focus of protracted public discussion since implementing a flat-rate pricing structure for its eight million subscribers in December 1996. Even before that event, its growth was substantial, as shown in the following table.

Table: America Online Incorporated – Usage Parameters[15]

Parameter	Dec. 1995	Sep. 1996	Jan. 1997
Average Daily Use	13 minutes	14 minutes	32 minutes
Daily Sessions	3 million	6 million	10 million
Total Hours Daily	960,000	1.5 million	4.2 million
Total Hours Per Month	30 million	45 million	125 million
Total Number Of Users At One Time	88,000	140,000	260,000
Average Session Length	17 minutes	16 minutes	26 minutes

GROWTH OF THE COMMERCIAL INTERNET SERVICE INDUSTRY

Another measure of the growth of the Commercial Internet Service Industry is the increase in the number of ISPs, an increase that has kept pace with the growing population of consumers. This also is reported in the *Internet Service Provider Directory*.

Table: Internet Service Providers[16]

Internet Service Provider Directory	Number of ISPs Listed
1st edition, March, 1996	1,455
2nd edition, Summer, 1996	2,266
3rd edition, Fall, 1996	3,068

[15] Reported in the *San Francisco Chronicle*, January 17, 1997 and *The Dallas Morning News*, January 17, 1997.

[16] Rickard, Jack, "Introduction to the Directory of Internet Service Providers."

REVENUE VERSUS COST FOR ISPS

The Commercial Internet Service Industry is a profitable business. Any question about this profitability is answered implicitly by the steady increase in the number of providers entering the industry. Nevertheless, it is useful to consider some specific information about the costs incurred and the profits generated by a typical ISP.

Again according to the *Internet Service Providers Directory*:

> The average ISP adds 143.23 new customers to [its] existing 1843.53 customers each month, an annual growth rate of some 93%. And the average hardware/software cost to support a new customer would appear to be $89.83. Connectivity costs per customer, using the 8.47 customer per port number and an average $2300 monthly per T-1 would appear to be $2.53 per customer per month or $30.45 per year per customer. The average price for a dialup connection is almost exactly $19.95 or $239.40 per year income per customer for a basic dialup connection.[17]

There is sufficient total revenue in the Commercial Internet Service Industry to attract even Mega-corporations such as AT&T and MCI. MCI has been a major player in the industry for many years as a backbone carrier of almost one-third of all Internet traffic. Revenues from the ISP industry were estimated at US$ 521 million per year in March 1996. MCI's analysis suggested this would grow to more than US$ 2.5 billion within eighteen months."[18]

Trends in Usage – The Georgia Tech Surveys

In their sixth survey of the industry, the Georgia Tech Research Corporation assembled some significant statistics on the pattern of Internet usage. The authors of the survey distinguish between frequency of use and hours that a user is on-line, a convention we maintain.

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[17] Rickard, Jack, "Introduction to the Directory of Internet Service Providers."
[18] Pizzo, Stephen, "ISPs are Dead Meat Says Analyst," http://webreview.com/96/03/22/news/isp2.html, March 21, 1996.

According to the survey results, frequency of use has remained relatively constant during the past eighteen months. Almost 46% of the respondents reported using the Web between one and four times per day. Almost 36% report using the Web more frequently on a daily basis, while approximately 18% use it less frequently. The authors state that this suggests a "regular and steady daily use, with 81.88% reporting using their browser at least once a day."[19]

The survey results demonstrate significantly different results for hours used, however. The survey reports that more than 20% of the respondents are using their browsers more than 20 hours per week.

Table: Weekly Web Usage[20]

Hours Used Each Week	Percentage of Respondents
More than 20 hours	20.05%
10 to 20 hours	30.01%
7 to 9 hours	17.00%
4 to 6 hours	17.76%
Fewer than 4 hours	15.18%

Another clear indication of the trend in Internet usage is provided by the extent of electronic mail usage. Virtually all Web users – 98.21% -- have and use electronic mail. From this same population, only 74.17% reported using traditional mail, or "snail mail," a term coined by electronic mail users.[21]

More Growth Expected

[19] Georgia Tech Research Corporation, "Frequency of Use," http://www.cc.gatech.edu/gvu/user_surveys/survey-10-1996/bulleted/.
[20] Georgia Tech Research Corporation, "Hours Used," http://www.cc.gatech.edu/gvu/user_surveys/survey-10-1996/bulleted/.
[21] Georgia Tech Research Corporation, "Use of Communications Technology," http://www.cc.gatech.edu/gvu/user_surveys/survey-10-1996/bulleted/.

There is no reason to believe that these rates of growth will diminish in the near future. Rather, we might reasonably forecast the same or even higher levels of demand as new methods of access and new applications stimulate the popular imagination. One such new method of access is the WebTV™, a commercial manifestation of the notion -- barely two years old – that a computer is not necessary to enjoy the Internet.

> WebTV is actually two elements that work together to package and deliver Internet content to the home over a standard telephone line and TV set. The hardware consists of a set-top box containing the integrated devices which connect to the Internet and deliver content to the TV screen. A keyboard allows users to browse through content, as well as compose e-mail messages.[22]

An example of a new application that is beginning to provoke both thought and planning is the development of real audio and video services on the Internet. As one observer noted, "this will induce an enormous load on the Internet infrastructure, and the data has to be transferred at terabyte rates through many nodes."[23]

As the development and implementation of these and other new applications accelerate, so does the interest of ISPs.

> These companies see enormous potential for growth and development of the services provided on The Internet. In effect The Internet will become a worldwide or global economy in itself with consumers armed with sophisticated access tools and firms providing digital services.[24]

In this regard, it is merely common sense to agree with John McQuillan who observed that "The Internet is the public data network, and many people assume it will become almost as large as the public telephone network."[25] It was only in 1995 that the sales of

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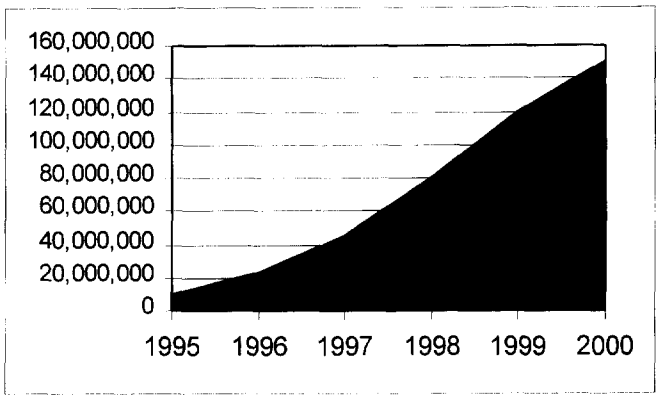
[22] Editors, "WebTV Brings the Internet to Couch Potatoes," *Rural Telecommunications*, January/February, 1997, page 9.
[23] Gupta et al, page 2.
[24] Gupta *et al*, page 2.
[25] McQuillan, John, "Rebuilding the Public Infrastructure for Data," *Business Communications Revenue*, December 1996, page 14.

home computers exceeded the sales of televisions in the United States.[26]

The firm Nonlinear Systems portrays this growth in the number of users as shown in the following figure.[27]



Inferior Connections Incorrectly Blamed on PSTN

One additional measure of the maturity of the Commercial Internet Service Industry is the confidence people experience upon hearing the pronouncements of spokespeople. Before the Internet became an industry, it was characterized in the popular imagination as the playground of academics, computer hackers and technology "nerds." Now international conglomerates such as Philips Magnavox, Sony and Microsoft represent the Internet Industry. In turn, these multi-billion dollar companies are represented in advertisements delivered by prestigious individuals speaking in sonorous tones of the quality of life in the future.

As these firms promote the commercial development of the Internet, there is an expectation among the general public that the supporting infrastructure is adequate to the task. This is not the case, however. The telecommunications industry rightfully expects innovations such as WebTV™ to amplify the already significant impact of commercial Internet traffic on the PSTN.

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[26] http://citywideguide.com/InternetUsers.html, citing *USA Today*.
[27] http://www.nlinear.com/demographics.html.

Unsuccessful call attempts made by Internet subscribers to ISPs affect other users of the PSTN, not just other subscribers attempting to call the same ISP. Even in a network that uses advanced technology such as Signaling System 7 ("SS7"), unsuccessful attempts by Internet users to connect to their ISPs pose problems. Only recently have engineers begun to understand the true nature of these problems and begun to design appropriate solutions.

These problems, elaborated elsewhere in this report, reflect in large part, the dramatic change in the nature of the demand being placed on our circuit switched telephone networks: the PSTN was designed to carry voice traffic. It is a national resource that is optimized for one particular activity, one particular type of traffic, and it works well every day, nationwide.

If professional telephone engineers were to design a new PSTN from scratch, with full knowledge of the types of traffic they would be carrying, we know the system would be configured differently. Unfortunately, the American PSTN does not have the luxury of ignoring the existing investment in equipment, cables and hardware that currently provides the nation with voice communications capable of unrivalled quality. Nevertheless, we know that designers would approach the problem differently if they had this option. For example, the new telephone systems being built throughout the developing world, such as TIME Telecommunications in Malaysia, Macomnet in Russia and the Fiber Loop Around the Globe (FLAG) all assume data traffic. All are being built with advanced synchronous digital hierarchy ("SDH") or synchronous optical network ("SONET") technology. And many are being built with the participation of American designers.

There is no question that America's network must be upgraded to support the Commercial Internet Service Industry. During this process, users will inevitably experience delays and frustration. Unfortunately, although the nation's telephone

professionals and Local Exchange Carriers ("LEC") are not responsible for problems such as these, they often are blamed by misleading analyses that appear in the popular press. Many ISPs are providing inferior connections, but blame is placed with the LEC, creating significant ill will in the public mind. As Ray Albers, Vice President of Technology Planning for Bell Atlantic observed, "In this whole scene here, it's hard for us to look like we're not wearing the black hats."[28]

> ISPs are very different from telephone companies. For example, ISPs rent their transport – often from telcos. By contrast, when the telephone companies offer data services, they usually do so using their own underlying transport facilities. This has consequences for the nature of the Internet. The carriers have invested billions of dollars in an infrastructure that can recover promptly after disasters, keep running during power outages and deliver predictable service levels, day in and day out. By contrast, most ISPs have not hardened their points of presence (POPs) and cannot offer service-level guarantees.[29]

We argue in this report that because the true cause of the problem is the commercial success of the Internet Service Industry, that same industry should accept responsibility for participating in the correction of the problem.

[28] Krapf, Eric, "Why the 'Net Won't Cause PSTN Meltdown," *Business Communications Review*, December 1996, page 37

[29] McQuillan, December 1996, page 14.

Nature of the Problem

Commercial Use of A Public Resource

One aspect of the problem posed by the Commercial Internet Service Industry is its commandeering and consumption of a public resource. John McQuillan refers to this particular problem as the "tragedy of the commons."

> The commons in early New England towns were a free public resource: everyone could graze their animals there. As long as the commons were large and the town population was small, everything was fine. But when usage reached a certain level, the commons became overgrazed and there was no resource left for anyone. The lesson is that shared resources either must have prices that reflect their costs, or prices and access must be regulated.[30]

In effect, a national resource – the PSTN – is being co-opted and used for commercial gain without reasonable consideration for the other users of the network. This has prompted extraordinary efforts by the nation's LECs to maintain the integrity of the PSTN and to maintain the Quality of Service for all subscribers.

Moreover, the PSTN is being co-opted and used for commercial gain without adequate compensation to the operators of the network. Without such compensation, it is difficult for these operators to justify the expenditures necessary to offer the quality of service demanded by Internet corporations. We emphasize that these are expenditures over and above those that are necessary for the universal basic service mandated by the FCC.

Impact on the PSTN

Another aspect of the problem posed by the Commercial Internet Service Industry is the

[30] McQuillan, December 1996, page 16.

nature of the demands that the industry makes on the PSTN. These demands are very different from the demands made by the voice traffic for which designers of the PSTN understandably designed the network. "Due to the visual nature of the Internet, individual sessions tend to match TV viewing habits rather the traditional telephone calling habits. ...Calls involving use of the Internet are much longer than [predicted by] the assumptions underlying development of the circuit switched network."[31]

This fundamental difference in the average length of calls had widespread consequences for traffic on the PSTN, particularly on its trunking components and its switching components. As a prominent team of academic economists noted,

> The Internet is already experiencing traffic jams. Given the growth rate of The Internet and the need to provide real time services in future, this congestion will become a severe problem if proper coordinating mechanisms are not designed and implemented.[32]

In the interests of determining the true impact of Commercial Internet Service on the PSTN, the FCC solicited comment on the matter in 1996. The telephone industry responded with four lengthy, empirical studies that detailed the nature of the problem.[33] These professional studies are a part of the public record for these matters and constitute a solid basis for analysis.

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[31] Stevens, Timothy, "Speech at NARUC Internet Forum," February 22, 1997 (typescript, page 2).

[32] Gupta, Alok, Dale O. Stahl, Dale O. and Whinston, Andrew B., "Pricing of Services on The Internet," NSF #IRI-9225010, http://cism.bus.utexas.edu/alok/pricing.html, 1996(?), page 1.

[33] These studies are "Pacific Bell ESP Impact Study," July 2, 1996 (Correspondence: Alan F. Ciamparcera, Vice President, Pacific Telesis to James Schlichting, Chief, Competitive Pricing Division, Common Carrier Bureau, Federal Communications Commission);
"US West Communications ESP Network Study – Final Results," October 1, 1996 (Correspondence: Glenn Brown, Executive Director, Public Policy, US West to James Schlichting, Chief, Competitive Pricing Division, Common Carrier Bureau, Federal Communications Commission);
"Report of Bell Atlantic on Internet Traffic," June 28, 1996 (Correspondence: Joseph J. Mulieri, Director, FCC Relations, Bell Atlantic to James Schlichting, Chief, Competitive Pricing Division, Common Carrier Bureau, Federal Communications Commission; and
Response of NYNEX to requests for information regarding traffic capacity problems arising from the ESP exemption, July 10, 1996 (Correspondence: Kenneth Rust, Director, Federal Regulatory Matter, NYNEX to James Schlichting, Chief, Competitive Pricing Division, Common Carrier Bureau, Federal Communications Commission).

Professional, empirical traffic studies such as those filed by the telephone companies have formed the basis for telephone industry planning and engineering decisions for more than a century. They represent solid evidence of actual system use under a variety of circumstances and scenarios. The validity of these studies, and hundreds of others that report similar findings albeit in different formats, is beyond question. If the results were inaccurate in substance, the PSTN would long ago have fallen into disarray and disuse.

The very few critics of published traffic studies are ill informed and appear to be basing their comments on erroneous interpretations of the information presented in these studies. The telephone industry has expressed its willingness to repeat the exercise using the specific format of the four reports cited here. However, there is no rational reason to expect the results would change substantially, other than to reflect the increasing severity of the problem and thereby to reinforce the nature of the problem. The several smaller case studies cited in this report provide the same reinforcement with additional examples of the problem.

In essence, these empirical studies detail the nature and extent of the impact problem by looking at sample wire centers distributed through the service areas of four regional Bell holding companies: Bell Atlantic, US West, Pacific Telesis and NYNEX. The results were predictably consistent: the problem is, after all, national and perhaps international in scope. Rather than repeat the material presented in the four studies, we will examine a published summary of the Bell Atlantic study, which is representative of the evidence.[34]

CONGESTION ON SWITCHES

The telephone industry uses a parameter known as "hundred call seconds" ("CCS") to

[34] Bell Atlantic, "Report of Bell Atlantic on Internet Traffic," http://www.ba.com/ea/fcc/report.htm, March 1996. See also Stevens, Timothy K. and Sylvester, James E., "Superhighway Traffic Taxes Current LEC Networks," *Telephony Magazine*, July 29, 1996.

measure the volume of traffic carried in a switch. With 3,600 seconds in one hour, there are 36 CCS in one hour. In other words, the maximum traffic that a full period circuit can carry would be 36 CCS.

Bell Atlantic defined a sample of wire centers from three states. These wire centers were selected because they served ISPs and therefore would provide information about the specific impact of ISPs on the network. To establish a control population, Bell Atlantic also identified a population of non-ISP businesses that used multi-line hunt group ("MLHG") equipment comparable to that used by the ISPs.

During a four-week period, the LEC determined the time for each completed call per line. Usage information was accumulated on an hourly basis and converted into hourly CCS data. The average usage for the peak usage hour for segment is shown here:

Table: Average Peak Switch Usage and Peak Hour, by Business Segment[35]

SAMPLE SEGMENT	AVERAGE PEAK	PEAK HOUR
ISPs with measured business (1 Mb) service	26 CCS	11:00 PM
ISPs with Primary Rate Interface ("PRI") service	28 CCS	10:00 PM
Business Customers with MLHG	12 CCS	5:00 PM
Office average (entire central office)	3 CCS	4:00 PM

The authors of the study noted:

> The network elements most affected by heavy traffic loads from ISPs are line units, switch modules and interoffice trunking. Per subscriber line served, these units generally result in a capital cost of approximately $245. This assumes the normal traffic load of 3 to 4 CCS. However, as CCS approaches 30, the capital costs for these units approaches $2400 per subscriber line, because of the reduced number of lines they can serve and the increase in interoffice traffic. As shown below, this translates into an approximate monthly cost per subscriber line of $75, compared to the average tariff rate of about $17 per month.[36]

[35] Report of Bell Atlantic, March 1996, page 3.
[36] Report of Bell Atlantic, March 1996, page 5.

CONGESTION ON TRUNKS

Commercial Internet traffic also creates congestion on the trunk lines that serve the PSTN. It has been argued that this type of congestion, where experienced, is insignificant in the context of the traffic in the network as a whole. However, the increase in traffic is a problem precisely because it is very localized. The demand for trunks saturates the facilities in a given local area. Consequently, the average availability throughout the system is irrelevant: trunks that are idle in Manhattan, Kansas cannot be used to satisfy demand in Manhattan, New York.

The Bell Atlantic study confirmed this problem.

> Interoffice facilities (IOF) requirements are also engineered to meet peak requirements. The peak busy hour for IOF trunks will vary throughout the network, and is influenced by community of interest factors associated with customers served by the central offices. The emergence of Internet traffic has greatly increased the amount of IOF required to provide acceptable levels of service to all end users (regardless of whether PRI or analog lines are used).[37]

Commercial Internet traffic affects the PSTN in two interrelated ways. It creates congestion at the switch and it creates congestion in the trunk lines. Both problems can be corrected, at a cost, as discussed below. The point we wish to emphasize now is that these impacts are directly related structurally to the temporary subsidy afforded to the Commercial Internet Service Industry.

Observed Conditions in a LEC Case Study Area

The USTA has provided another, as yet unpublished, case study for review that documents trunk line occupancy by the Commercial Internet Service Industry. The

[37] Report of Bell Atlantic, March 1996, page 3.

central office is located in a suburban serving area, in the immediate vicinity of a major metropolitan area. The office contains a medium-to-large end office switch with a number of remote switches homing on a tandem. The tandem is also an end office, with a smaller line count than the distant switch. A number of ISPs have nodes connected to the tandem and both offices are in an Extended Area Service ("EAS") area.

Table: Case Study Area Trunk Requirements

Year	Trunks
1992	95
1993	95
1994	140
1995	180
1996	380
February, 1997	432

As shown in this table, the number of trunks in service increased particularly rapidly within the case study during the period 1995-1996. Nevertheless, the average holding time for all calls on these trunks rose from 2.21 minutes in 1994 to 5.43 minutes in 1996, an increase of 145%. By comparison, the average holding time for interexchange toll calls went from 2.24 minutes in 1994 to 2.38 minutes in 1996, an increase of only 6.25%. This later category of calls may be presumed to be predominantly voice calls, rather than data, due to the usage pricing of toll calls.Studies of average holding times for two local ISPs report 22.28 minutes and 33.67 minutes respectively. Collectively these two ISPs generated 7.9 million minutes of usage in February 1997. In a small network (106 million minutes in February), these two ISPs accounted for 7.5% of the total network minutes. These figures and rates increases are substantial in terms of telco traffic engineering and clearly represent an unexpected and non-traditional condition for network usage and design.

Additional Case Studies

US WEST

US West recently completed a study of ESP traffic. Four inter-related types of ESPs were considered: value added networks, bulletin board services, on-line providers and Internet service providers. The results of this study were used to prepare a conservative five-year projection of ESP usage and line requirements.

The authors of the study estimated ESP usage in 1996 to be approximately 98,000 lines. They forecast usage in 2001 to be 328,625 lines, using current growth rates. Based on current line growth projections developed with the same methodology, these figures translate to 0.72% of the company's total lines in 1996 and 1.30% of the company's total lines in 2001. ESP usage was estimated to be 14.3 billion minutes of use ("MOU"), or 5.63% of the company's total in 1996. This usage is forecast to be 34 billion MOU by 2001, or almost 9% of the company's total.

NORTH PITTSBURGH TELEPHONY COMPANY

Demonstrating that this is not a phenomenon restricted to the largest operating companies, North Pittsburgh Telephone Company has also experienced and studied the impact of the Internet on the PSTN. North Pittsburgh Telephone has installed 290 additional free service trunks between the company's two host offices over the last four years to handle growth due to Internet traffic. They have clearly identified the Internet as the cause from an analysis of growth rates. Based on the historical record and local demographic trends, North Pittsburgh Telephone projected a somewhat aggressive trunk growth rate of approximately 10% per year. The company attributes the actual growth rates of 50%, 33% and 100% growth in 1994, 1995 and 1996, respectively, to the establishment of ISPs in their service area.

Since January 1, 1997, the company has added 48 additional trunks on this route for a

growth rate of 12.5% during just the first three months of the year. Assuming a cost of $1300 per trunk, this equates to an additional investment of $377,000 over the last four years. This number will clearly increase before the end of the year.

SOUTHERN NEW ENGLAND TELEPHONE COMPANY

Southern New England Telephone Company ("SNET") recently studied a mid-sized switch in a rural area serving 11,000 lines over a host and remote switch arrangement. Service for a major ISP transport customer was provided initially in the remote portion of the switch. The service consisted of 240 lines configured in a Multi-Line-Hunt group. When the serving office initiated service to the ISP, Dial Tone Delay and Terminating Blockage immediately exceeded service objectives, resulting in numerous customer trouble reports.

As a result, the telephone operating company moved the 240 lines to the Host switch and carefully assigned the lines across the serving equipment in the Host to prevent blockage and minimize further customer impact. A study of this office and this customer was initiated and the following measurements were obtained.The Host serves approximately 6,257 lines. The ISP increased their service to 336 lines just prior to this study. The Busy Hour for this office is now 7:00 PM to 8:00 PM, local time. The average CCS per Network Access Line ("NAL") attributable to the ISP equaled 35.8 CCS compared to 5.5 CCS for all NALs within the service area. Removing the 336 ISP lines from the calculation resulted in an average measurement of 3.7 CCS per NAL.

The total load from the ISP during the Busy Hour equaled 12,037 CCS and the total load from all sources during the Busy Hour equaled 34,216. Three hundred and thirty six lines, representing 5% of the total lines assigned in this Host, used 35% of the total offered load for this switch. The average number of minutes of use per terminating call to this ISP was 21 minutes. SNET concluded from these findings that the ISP consumed a disproportionate amount of switch capacity compared to the average non-

ISP subscriber assigned in this office.

Economic Impact of Subsidy

The temporary subsidy that the Commercial Internet Service Industry has enjoyed for more than a decade has skewed the industry's use of the PSTN in several ways. We emphasize that the skew is not the result of illegal or illicit activity. Rather, it is the result of rational behavior in an artificial pricing environment.

One way in which the ISPs take advantage of both the subsidy and the current local service tariff structure to the disadvantage of other subscribers is in the location of their modem pools. ISPs place modem pools in free-calling areas to benefit their subscribers. The traffic is then carried to the ISP over trunks that are more heavily congested than would otherwise be the case.

Because of the subsidy (that is, their temporary exemption from access charges, ISPs erroneously consider Internet traffic as "local" in jurisdiction. Therefore Entrant Local Exchange Carriers ("ELEC") have an incentive to implement special arrangements to carry traffic for ISPs. Under such an arrangement, traffic intended for an ISP is first routed to an ELEC, which collects terminating local charges from the Incumbent Local Exchange Carriers ("ILEC") before passing the traffic to the ISP.[38]

Concern about such arrangements grows when the ELEC and the ISP are part of the same company. We recognize that ELECs would benefit from this interpretation of the interconnection rules, but as one professional asked "one wonders what the public policy benefits of these arrangements could possibly be."[39]

Another example of the economic effects of the temporary subsidy is related to the

[38] This is a variation of the "leaky PBX" problem considered in CC Docket No. 83-356, ¶80, page 712
[39] Stevens speech, page 8.

duration of the calls. One Internet user described his usage pattern as follows.

> I sometimes stay logged on for hours in a hotel room and pay only 75 cents, and I expect many of you do as well. This means that those of us dialing into the Internet often pay nothing for the call, and the ISPs pay nothing because they do not initiate the call. The local carriers do not receive any access charges for long distance use of the Internet. The result is predictable: Local Internet dialup is overused, misused and abused. The Internet is killing the POTS ["Plain Old Telephone Service"] infrastructure.[40]

Put simply, data-traffic telephone calls last substantially longer than voice-traffic telephone calls. The time required to order a pizza for home delivery is much less than the time required to download a color photograph of a menu displaying pizza options with Web links to soda choices and dessert alternatives.

SUB-OPTIMAL INVESTMENTS

The temporary subsidy has forced a pattern of sub-optimal investment. Although more technologically suitable alternatives to the PSTN are becoming available, the incentive for ISPs to avail themselves of these options will be dampened considerably as long as the subsidy keeps costs for access to the PSTN artificially low. As a result, these newer investments become harder to justify.

Moreover, the LECs are being driven to invest in ways that while they protect the PSTN, do not result in an infrastructure optimized for data. For example, Bell Atlantic provided a case study of the compensatory actions that a LEC must perform to accommodate the Commercial Internet Service Industry.

> The fix again involved spreading lines over multiple line switches, which required transfer of many residential and business customers to provide additional switching capacity for the ISP's lines. The labor and capital expense to accommodate the ISP's traffic are in effect allocated across all

[40] McQuillan, December 1996, page 14.

other customers.[41]

Bell Atlantic has reported in several publications and public forums that the company's total investment in special accommodations for Commercial Internet Service Industry traffic has been in excess of US$ 100 million. This investment continues to grow as Internet usage grows.

The LECs are adding circuit-switched capacity to meet the demands of the Commercial Internet Service Industry. There is no disagreement that this is an inappropriate technology for connections to the Internet and that packet-switched circuits would be preferable. However, because of the temporary subsidy, there is no mechanism to pay for the equipment and software necessary to build the packet-switched network. Moreover, there is no incentive for ISPs to use the more appropriate technology that is already available.

In effect, this means that network discretionary expenditures are being diverted to ISP subscribers rather than being used to enhance service for all subscribers. Moreover, network discretionary expenditures are being diverted to ISP subscribers rather than being used to reduce costs for all subscribers. These actions are not appropriate, particularly in the long-term.

Upgrades to the voice network to satisfy universal basic service needs are implicit in voice service subscriber tariffs. The upgrades needed to satisfy commercial data traffickers are not part of those tariffs because of the temporary subsidy.

The pricing issue is a significant barrier to the rational use of a national resource:

> Applications such as voice over the Internet can be most effective if the user's Internet connection stays on all the time. In effect, a circuit-switched architecture has been converted to a private line - as a result of

[41] Report of Bell Atlantic, March 1996, page 5.

> the pricing signal we are sending. Neither end users nor ISPs have sufficient incentive to utilize public switched network resources efficiently.[42]

SECOND LINE REVENUES

Some casual observers have suggested that the temporary subsidy is unrelated to the financial issues surrounding investment in appropriate technology. They argue that revenues from the sales of second telephone lines to Internet subscribers are adequate to pay for the necessary investment. This is not true, for several reasons.

First, second line revenues are inadequate. The LEC does receive the base income from a second line. However, the revenue from a second line is offset by the costs to provision the line itself and for voice traffic. The use of the second line for other purposes, such as Internet access, results in the switch and trunks being occupied with calls that last far longer than voice calls. The longer duration of the Internet calls still affects the traffic load, even if it is on a second line. The key issue is that the revenue from a flat rate second line is disproportionate to the cost of the switch that supports the Internet traffic.

Despite the obvious inadequacy of the second line revenue, this "red herring" is used frequently in the popular press. We will examine this argument again, in more detail, later in this report when we consider one particular example.

SHIFTING THE COST

The temporary subsidy has had the effect of shifting the cost of Internet access from the actual users to other users of the PSTN. These other users are subsidizing the commercial use of the Internet regardless of whether or not they are users of the enhanced service.

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[42] Report of Bell Atlantic, March 1996, page 6.

We recognize that the public good will be served by an explicit subsidy for schools, libraries and hospitals to obtain access to the information superhighway. This is a matter clearly supported by the Telecommunications Act of 1996, which states that all subsidies must be explicit. Indeed, there is support from virtually all quarters (except, obviously, the ISPs) for the elimination of implicit subsidies and hidden charges.[43] Put simply, enhanced service users should pay for their enhanced services.

Internet services are not included in the definition of universal service. To the extent that the Commission wishes to subsidize these services, it should do so explicitly.

As the USTA noted:

> ESPs pay fundamentally different prices than interexchange carriers for equivalent use of the network. As a result, ESPs are not only avoiding contributing to the full cost of their use of the local network, but are also being subsidized by other users of the network.[44]

The New "Leaky PBX"

The FCC expressed concern about what it termed "leaky PBX" in many of its hearings during the 1980s. The basic concern was that a long distance carrier could connect to a "leaky PBX" and gain access to the local loop without paying access charges. In effect, the LECs investment would be used without compensation. The FCC expressed a hope that such arrangements, if they arose, would fall into disuse as pricing

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[43] "There is widespread agreement in the comments that all explicit and implicit subsidies should be eliminated from access charges." AT&T Corporation, "Reply Comments of AT&T Corp." *In the Matter of Access Charge Reform, CC Docket No. 96-262; Price Cap Performance Review for Local Exchange Carriers, CC Docket No. 94-1; Transport Rate Structure and Pricing, CC Docket No. 91-213; and Usage of the Public Switched Network by Information Service and Internet Access Providers, CC Docket No. 96-263*, February 14, 1997, page 6.

[44] United States Telephone Association, "Comments of the United States Telephone Association," *In the Matter of America's Carriers Telecommunication Association Petition for Declaratory Ruling, Special Relief, and Institution of Rulemaking Regarding The Provision of Interstate and International Interexchange Telecommunications Service Via the Internet by Non-Tariffed Uncertified Entities*, RM-8775, May 8, 1996, page 2.

structures adjusted to the market place.

The 1990s version of the leaky PBX is voice communication on the Internet. Software designed to provide this service is widely available on the Internet and in retail stores. This software allows users to complete voice communications between a computer at the one end and a telephone at the other end. The voice quality is becoming quite good, in part because of the rapid diffusion of higher speed modems.

> The use of Internet for voice communications is likely to spread significantly. It is appropriate to allow Internet providers to compete directly with interexchange carriers, but to exempt the Internet providers from the same charges placed on interexchange carriers is inappropriate. Such price distortions are the antithesis of the competitive market that the Telecommunications Act of 1996 was intended to promote. They are also inconsistent with the "a minute is a minute" approach that the Commission has embraced in other contexts.[45]

Summary

We have demonstrated the nature of the problem of Commercial Internet Service Industry access to the PSTN. Additional examples of empirical studies are part of the public record and are available for review. The examples cited, however, are sufficient to compel action to maintain the integrity of the PSTN.

[45] General Communication, Inc., "Reply Comments of General Communication, Inc.," In the Matter of Access Charge Reform, CC Docket No. 96-262; Price Cap Performance Review for Local Exchange Carriers, CC Docket No. 94-1; Transport Rate Structure and Pricing, CC Docket No. 91-213; and Usage of the Public Switched Network by Information Service and Internet Access Providers, CC Docket No. 96-263, February 14, 1997, pages 12-13.

Comments by Selwyn and Laszlo

Introduction

While recognizing the value of open and free discourse and debate, we also recognize the constraints imposed by common sense and legal precedent. As Mr. Justice Oliver Wendell Holmes (1841-1935) observed almost eighty years ago, "The most stringent protection of free speech would not protect a man in falsely shouting fire in a theater, and causing panic."[46] Accountability for the veracity of one's public comments is a fundamental and reasonable expectation.

We have reviewed a paper commissioned by the Internet Access Coalition. In their paper on the effect of Internet use on America's PSTN, the authors presented a distorted, idiosyncratic and, in many respects, peculiar impression of the issues under discussion.[47] There are numerous examples to support this comment scattered throughout their paper, but the few cases cited below will suffice to demonstrate the nature of the problem.

Methodology

Several LECs and Bellcore have conducted studies to determine empirically the nature and extent of impact of ISP demand on the nation's PSTN. Selwyn and Laszlo dismiss these studies in their Executive Summary by arguing that studying 127 central offices and switching entities is inappropriate.[48] One fundamental principle of social science is that researchers may extrapolate in a meaningful fashion from a population sample. To allege, as Selwyn and Laszlo do, that use of a sample population merely demonstrates

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[46] Holmes, Oliver Wendell, Opinion of the Court in Schenck v. United States, 249 U.S. 47 (1919).
[47] Selwyn, Lee L. and Laszlo, Joseph W., "The Effect of Internet Use on the Nation's Telephone Network" (prepared for the Internet Access Coalition), Boston: Economics and Technology, Inc., January 22, 1997.
[48] A sample of this size cannot accurately be categorized as a handful, as Selwyn and Laszlo January 22, 1997, asserted on page vi.

ad hoc problems rather than systemic issues indicates a poor understanding of the principles underlying the methodology.

Economic Arguments

TARIFFS

Selwyn and Laszlo state that LECs typically charge more for T-1 arrangements than for less efficient analog service arrangements.[49] Their analysis fails to consider that analog service arrangements have concentration (for example, 4:1) while T-1 services do not. If the price of an analog line is adjusted to reflect the 1:1 concentration ratio of a trunk, the prices prove to be appropriate and comparable.

Selwyn and Laszlo ignore another reason why analog circuits are priced differently from T-1. Analog circuits are heavily regulated and the prices charged are subject to regulatory manipulation for public policy reasons (that is, by forces other than the marketplace). Moreover, T-1 lines provide greater throughput, with less blocking; the price structure reflects the quality of the product.

THE HYPOTHETICAL SECOND LINE

The next peculiar argument is somewhat tortuous, involving as it does several leaps of faith regarding the definition of revenue. Selwyn and Laszlo first argue that "in 1995 alone, some 6-million residential subscriber lines were used exclusively or primarily for online access."[50] The spurious nature of this assertion is obvious. Several trends in telephone usage are conflated in reports of second line installation. Among the many reasons people add second lines are:

1. home office[51] and telecommuting voice line for wage earner/spouse A

[49] Selwyn and Laszlo, January 22, 1997, page 16.
[50] Selwyn and Laszlo, January 22, 1997, page vii.
[51] We distinguish between a home office, which is used for the convenience of telecommuters to supplement a corporate office, and a home business, which serves as the primary place of business.

2. home office and telecommuting facsimile line for wage earner/spouse A
3. home business voice line for wage earner/spouse A
4. home business facsimile line for wage earner/spouse A
5. home office and telecommuting voice line for wage earner/spouse B
6. home office and telecommuting facsimile line for wage earner/spouse B
7. home business voice line for wage earner/spouse B
8. home business facsimile line for wage earner/spouse B
9. children's phone(s)

The recent, rapid growth of telecommuting and home businesses in the United States would skew any traditional second line usage analysis. For example, there are now more than 5 million home businesses operating in the United States. This fact renders categories 3, 4, 7 and 8 much more significant than the Selwyn and Laszlo study would allow. Indeed, we might expect that home offices would add at least two additional lines for voice and facsimile transmissions.

The growth in the number of two-income families exacerbates this trend. Not only categories 1 through 4, but also categories 5 through 8, reflect the true usage of many second (or third lines). There also is ample demographic evidence (specifically, birth rates and aging statistics) to predict rapid growth in demand for second and third residential voice lines for children.

Notice that none of these reasons may be confused with exclusive or primary use for Internet access. Indeed, there appears to be no valid reason to assert that these second line subscribers even desire Internet access, much less desire to subsidize Internet access by other people. Informed discussion and debate demands more substantial evidence.

Having misinterpreted the basic rationale for second lines, Selwyn and Laszlo amplified the error by applying a "churn factor" multiplier. This churn factor assumed that Internet users have telephone lines disconnected and reconnected at a more frenetic pace than other users and in so doing generate disproportionate additional revenue for the LECs. There are myriad reasons why telephone lines are disconnected, including:

1. moving residences
2. non-payment of bills
3. children going to college (reduced need for children's lines)
4. divorce (reduced demand for spouse use lines)
5. changing jobs
6. cessation of telecommuting
7. closing home offices
8. relocating home offices
9. retirement

Each item on this list could conceivably be the cause for multiple disconnections. Notice once again that none of these compelling reasons may be confused with exclusive or primary use for Internet access.

Moreover, we should consider actual observed usage before alleging, without basis, the proportion of second line sales related to the Internet service industry. For example, Selwyn and Laszlo note that additional residential lines increased 10.1% in 1994 and 9.6% in 1995.[52] How do they explain the fact that this growth rate was falling at the same time that the authors claim the Commercial Internet Service Industry usage was enjoying explosive growth?

REVENUE VERSUS PROFIT

Finally, in their argument regarding second line revenue, Selwyn and Laszlo confuse revenue with profit. They incorrectly allege, from the spurious statistics discussed above, that the several billion dollars in profit offset the substantial investments made by the LECs to support the Internet access. Even if the statistical basis was accurate, this argument ignores the cost of the equipment purchased, the cost of supplementary engineering time, the cost of installation labor, and the cost of maintenance programs (including labor). There are no huge windfall profits from the growth of second lines, regardless of the specific impetus. Rather there are reasonable, authorized revenues

[52] Selwyn and Laszlo, January 22, 1997, page 25.